

Harnessing Mobile Health Technologies to Improve Child Health Outcomes: A Systematic Review of Interventions for Under-5 Year Children in Low- and Middle-Income Countries

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ABSTRACT

Introduction: The global health policy's main goal is to reduce the under-five mortality rate (U5MR), especially in low- and middle-income countries (LMICs), where children still die of various ailments. Mobile-Based Health (mHealth) methods may help improve health information and access to maternity and childcare services. This systematic review was aimed to evaluate the efficacy of m-Health in enhancing the health of children under five in LMICs.

Methodology: A search strategy was carried out in the databases like PubMed, CINAHL, SCOPUS, Science Direct, PsycINFO including some grey literature with a focus on the studies published in English 2013 to 2024 were only included. From a total of 518 studies identified, twenty-two satisfied the criteria for inclusion after a selection process.

Results: The results emphasized the impact of m-Health in improving immunization rates, supporting breastfeeding, child growth monitoring, and health-seeking behaviours of the mothers. Text messaging, in particular, has been identified as a cost-effective and widely adopted mobile health approach for behaviour change, adherence to medical recommendations, and promoting healthcare service utilization.

Conclusion: The findings underscore the potential of digital health to bridge gaps in healthcare service delivery in resource-limited contexts, addressing critical shortages in human resources and infrastructure.

Keywords: m-Health, Under-5-year children, Mothers, LMICs

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INTRODUCTION

International health goals include reducing under-5 mortality. The Sustainable development goals (SDGs) aim to eliminate unnecessary deaths in children under five. Globally, newborn deaths declined from 5.2 million in 1990 to 2.3 million in 2022. Neonatal mortality reduced lower than post-neonatal under-5 mortality from 1990 to 2022. Nearly 47% of all child deaths under 5 occur daily, with 6300 infant deaths.¹ WHO reports that five nations account for almost 50% of under-5 mortality, i.e. India (17%), Nigeria (15%), Pakistan (8%), the Democratic Republic of the Congo (7%), and Angola (5%).²

Despite years of development in the health sector, many developing and least-developed countries still fall behind. In South Asia and Sub-Saharan Africa, several countries lack health care coverage and services. Developing countries face many obstacles to timely healthcare delivery. Many nations, particularly Africa, have embraced mHealth to improve access to important health care, with encouraging results. Universal health coverage also requires health providers to have access to information. mHealth can improve traditional healthcare systems and access to health treatments, especially in rural and isolated areas.³

Younger parents are finding traditional health communication less helpful. Many new mothers now choose to search for health information online, sometimes on their phones, according to research.⁴ The rapid growth of the digital technologies offers creative opportunities to develop mobile health interventions to improve mother-child care worldwide. By incorporating mobile technologies into healthcare systems, many challenges can be addressed, leading to better health outcomes.⁵

M-health is anticipated to increase the access to the quality healthcare services and information, and promote healthy behaviour to prevent acute and chronic illnesses while enhancing treatment adherence and outcomes.⁶ Due to swift expansion of digital connection, m-health technologies are becoming more widely acknowledged for their contribution in improving mother care, newborn and child health care outcomes in LMICs.⁷

A review of m-health applications for children under five in LMICs revealed that interventions like text message reminders enhanced the medication adherence, increased healthcare service utilization, promoted appointment compliance, and supported maternal education and behaviour change.⁸

Research on the effectiveness of mHealth interventions varies significantly in terms of design, targeted health outcomes, focus areas, and functionalities. Systematic review by Marcolino et al. found that behaviour change interventions using text messaging were among the most popular and effective mHealth approaches. However, the authors recommended

stronger research designs to validate the effectiveness of these interventions. Other systematic reviews have explored different mobile health technologies, focusing on mother care, new-born and child care, either separately or in combination among LMICs.⁸⁻¹⁰ However, to our knowledge, there has been no comprehensive review specifically assessing the effectiveness of mHealth interventions for the early detection, prevention, and management of common childhood illnesses, or the care of children under five in LMICs. The findings of this study will influence policy decisions and assist in the allocation of resources for future initiatives and research in resource limited areas.

METHODOLOGY

An extensive electronic literature search was performed across many databases, including PubMed, CINAHL, SCOPUS, Science Direct, and PsycINFO, to discover research published in English from 2013 to 2024. The search also extended to grey literature sources, such as Google Scholar, Google, and various health organization websites. Additionally, we employed a snowballing approach to identify relevant literature by (i) analysing the study protocols to identify publications detailing relevant intervention outcomes (ii) evaluating previously published reviews (iii) scrutinizing the reference lists of all articles included in the reviews. A detailed search was conducted using MeSH terminology and specific keywords including “Impact” or “Effectiveness”, “M-Health” or “Mobile Health” or “E-health”, “Early detection”, “Prevention”, “Management”, “Care of under-5 Child”, “Vaccination”, “Immunization”, “Breast-feeding”, “Growth and development”, “Common childhood illnesses.”

Selection Criteria: Two primary reviewers (MKG and KR) independently evaluated the titles, abstracts, and full-text articles of potentially relevant studies to determine their eligibility based on the inclusion and exclusion criteria. Inclusion Criteria: (i) Studies reporting the impact of M-health on the care of under-5-year children in LMICs. (ii) Mobile health interventions targeting improvement in immunization among under-5-year children in LMICs (iii) Studies related to impact of m-health in promotion of breastfeeding among under-5-year children. (iv) Studies related to use of m-health in monitoring of Growth and development of under-5 children in LMICs. (v) Studies reporting improvement of health seeking behaviour of the mothers by using m-health. Inclusion: Studies published in peer-reviewed journals, studies involving participants of LMICs according to the World Bank Index were included. We excluded the studies that were published before 2013. Outcomes were not pre-specified, as our focus was on all outcomes relevant to children under-five years. Therefore, we reported outcomes specifically related to children under-five years of age.

Data Extraction: A Comprehensive Systematic review following PRISMA guidelines was carried out by two authors to assess the impact of m-health on child health outcome from 2013 to 2024. Initially, 518 studies were identified. After applying the inclusion and exclusion criteria, 440 research papers were eliminated based upon their abstracts and titles. Af-

ter this elimination again 51 studies were reviewed further by the authors, resulting in the exclusion of 29 studies. In the end, 22 studies were included in the final review paper. Scrutinizing and final selection process is presented in Figure.1: accordance with the PRISMA 2009 guidelines.¹¹

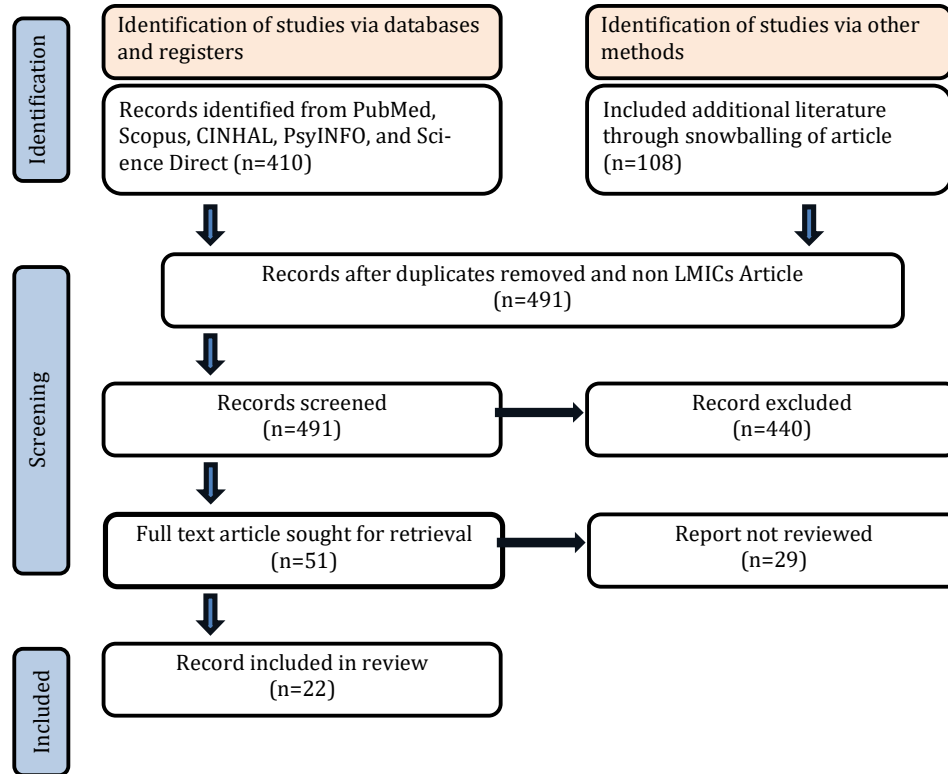


Figure 1: PRISMA flow diagram of the systematic review detailing the database searches, the number of abstracts screened and the full texts retrieved

RESULTS

Through extensive database searches, we found 410 research studies, supplemented by 110 additional studies sourced from published systematic reviews and reference lists. The screening and selection process, detailed in Figure 1, outlines the exclusion criteria applied at each stage. After the review, 22 studies were included: 17 randomized controlled trials (RCTs), three quasi-experimental studies, one descriptive study, and one methodological study. Geographically, the studies were conducted across several LMICs, with 14 taking place in Sub-Saharan Africa, specifically including six studies from Nigeria, five from Kenya, one each from Ethiopia, Zimbabwe and Côte d'Ivoire. Four studies were conducted in South Asian countries with Bangladesh (three studies) and India (one study) being the primary contributors. Two studies from West Africa and one each from Egypt, Uganda. The study populations primarily composed of mothers, caregivers, pregnant women, and children aged 0 to 5 years. In terms of the focus

and impact of the studies: The majority of studies (11 in total) focused on improving immunization coverage among children by raising awareness, improving attitudes, and providing timely vaccination reminders to mothers of under-5 children. Six studies investigated the use of mHealth to empower mothers in promoting exclusive breastfeeding (EBF). Three studies examined the important role of the mobile health technologies in the improvement of health seeking behaviours of the mothers of under-5 children. Two studies examined the effect of mobile Health interventions on improving mothers' abilities to monitor the regular parameters of the growth and development of their under-five year children, demonstrating a beneficial impact on these skills.

PEDro analysis to assess the methodological quality of the included studies was carried out and is depicted in the Table 1.

m-Health functions

By following the research studies in the review number of m-health function were identified.

Table 1: PEDro analysis for the methodological quality of the Literature included in the review

Research Studies	Total Score	Study's Methodological quality	PEDro item wise number										
			1	2	3	4	5	6	7	8	9	10	11
Yunusa U et.al,2025 Nigeria ¹⁵	6	Good	1	1	0	1	0	0	0	0	1	1	1
Mekonnen ZA, 2021, Ethiopia ¹⁸	7	Good	1	1	0	1	0	0	0	1	1	1	1
Ibraheem R, 2021, Nigeria ¹⁶	7	Good	1	1	0	1	0	0	0	1	1	1	1
Ekhaguere OA et.al,2019, Nigeria ²³	6	Good	1	1	0	1	0	0	0	0	1	1	1
Dissieka R, 2019, Cote d'Ivoire ¹⁹	6	Good	1	1	0	1	0	0	0	0	1	1	1
Odinaka K, 2018, Nigeria ¹⁷	4	Fair	1	0	0	1	0	0	0	0	1	0	1
Gibson DG, 2017, Kenya ¹³	7	Good	1	1	0	1	0	0	0	1	1	1	1
Schlumberger M et.al, West Africa, 2015 ²¹	6	Good	1	1	0	1	0	0	0	0	1	1	1
Uddin MJ et.al, Bangladesh 2015 ²⁰	5	Fair	1	0	0	1	0	0	0	0	1	1	1
Eze G et.al, Nigeria 2015 ²²	6	Good	1	1	0	1	0	0	0	0	1	1	1
Haji A et.al, Kenya, 2016 ¹⁴	7	Good	1	1	0	1	0	0	0	1	1	1	1
Bangure D et.al, Zimbabwe, 2013 ¹²	7	Good	1	1	0	1	0	0	0	1	1	1	1
Billah SK et.al, Bangladesh, 2022 ²⁴	7	Good	1	1	0	1	0	0	0	1	1	1	1
Adam M et.al, South Africa, 2021 ²⁹	6	Good	1	1	0	1	0	0	0	0	1	1	1
Jerin I, Bangladesh 2020 ²⁵	6	Good	1	0	0	1	0	0	0	1	1	1	1
Unger JA et.al, Kenya, 2018 ²⁷	6	Good	1	1	0	1	0	0	0	0	1	1	1
Patel A, India, 2018 ²⁸	6	Good	1	1	0	1	0	0	0	0	1	1	1
Flax VL, Nigeria, 2014 ²⁶	7	Good	1	1	0	1	0	0	0	1	1	1	1
Ibrahim NM, Egypt 2023 ³¹	5	Fair	1	0	0	1	0	0	0	1	0	1	1
Nyang'echi E, Kenya, 2021 ³⁰	6	Good	1	0	0	1	0	0	0	1	1	1	1
Musiimenta A, et.al, Uganda 2022 ³³	7	Good	1	1	0	1	0	0	0	1	1	1	1
Talisuna AO, et.al, Western Kenya, 2017 ³²	7	Good	1	1	0	1	0	0	0	1	1	1	1

Note: Review Studies were classified as having excellent (9-10), Good (6-8), fair (4-5) or poor (<4)

Scale of Item score: 0, absent; 1, present. The PEDro scale criteria are: (1) eligibility criteria (2) random allocation, (3) Concealed allocation, (4) similarity at baseline on key measure, (5) subject blinding, (6) therapist blinding, (8) more than 85% follow-up at least 1 key outcome, (9) intention-to treat analysis, (10) between-group comparison for at least one key outcome, and (11) point estimates and measures of variability provided for at least one key outcome.

(i) Behavior Change Communication (BCC): By delivering timely and relevant information via SMS, phone calls, or app-based reminders, m-health interventions can help in change the health-related behaviors. This works especially well to promote vaccination adherence, exclusive breastfeeding, regular follow up and growth monitoring of the child. **(ii) Educating:** Prenatal care, child development monitoring, vaccination schedules, and other crucial mother and child health practices are the main topics of interventions. **(iii) Impact on Health Outcomes:** The evaluated research demonstrates how m-health interventions can improve children's health outcomes. It included improved breastfeeding practices, higher vaccination rates, and fewer postpartum care dropouts. **(iv) Tracking Important Events:** Vital events including a child's growth and development, immunization schedules, and pregnancy milestones can be tracked with the help of mHealth tools. **(v) Treatment Adherence and Follow-up:** m-health is used to enhance treatment adherence and follow-up. Mothers are encouraged to attend planned check-ups for their children and follow recommended interventions when they get regular reminders via voice or text messages.

IMPACT OF MOBILE HEALTH TECHNOLOGIES ON CHILD HEALTH OUTCOMES

Improving Child Immunization: In total, 12 studies were identified to assess the impact of m-health in the improvement of the childhood immunization rates among low- and middle-income countries

(LMICs). It includes ten Randomized Controlled trials (RCTs) studies and one quasi-experimental study and one descriptive study. These studies were conducted across multiple regions, including Nigeria (5 studies), Kenya (2 studies), Zimbabwe, Ethiopia, Bangladesh, Côte d'Ivoire, and Africa as a region. All studies demonstrated that mHealth interventions positively impacted immunization rates and related outcomes.¹²⁻²³

A study carried out in Zimbabwe with 304 participants, evenly divided between an intervention group (152) and a control group (152), utilized SMS reminders. The results revealed significantly improved immunization coverage among intervention subjects than among control. At six weeks, intervention group achieved 97% coverage, compared to the 82 % among without intervention subjects at $p < 0.001$. The immunization coverage was 95% by the 14 week and 75% among the other group at $p < 0.001$ level.¹²

Two studies conducted in Kenya demonstrated notable improvements in immunization outcomes. In one study, it was found that 86% of children were fully immunized by 12 months of age in the intervention group.¹³ According to another study, moms who got the reminder texts had a lower likelihood of missing their vaccination regimens than the control group (OR:0.2, [95% CI: 0.04-0.8]).¹⁴

Numerous researches conducted in Nigeria assessed how smartphone reminders affected vaccination results. In one of the studies, it was identified that after the mobile intervention to one group the vaccination

completeness rates were increased (61.5%) and timeliness (50.2%) compared to 13.4% and 5% of the control group, respectively; $p < 0.001$.¹⁵ Another study with 140 participants compared various m-Health interventions, including SMS reminders and immunization fact messages, with standard care. The findings identified that the Group A, who received (SMS reminders) were found highest likelihood of attending immunization appointments on time “(AOR: 8.78 [95% CI: 6.10–12.63])”, followed by the Group B who received (immunization fact messages) (AOR: 2.56 [95% CI: 1.96–3.35]) and the last Group C (control group with standard care) (AOR: 2.44 [95% CI: 1.87–3.18]).¹⁶ Additionally, a descriptive study from Nigeria reported that 75.9% of mothers believed reminders could help reduce missed immunization appointments.¹⁷

According to a study with 426 participants in Ethiopia, the intervention group's immunization rates were noticeably greater than those of the control group. The results showed that coverage for Penta-3, measles, and full vaccination was 95.8%, 91.5%, and 82.6%, respectively, in the intervention group, compared to 86.9%, 79.3%, and 70.9% among the other group ($p < 0.001$ level) Rates of timely vaccination were also increased the group who received intervention, with risk ratios of 1.17 (95% CI: 1.07) for full vaccination and 1.59 (95% CI: 1.35) for scheduled vaccinations.¹⁸

Similarly, studies conducted in Côte d'Ivoire, Bangladesh, and across Africa, 2 Nigeria consistently reported improvements in immunization coverage and adherence to schedules with mHealth interventions.^{19–23} These findings highlight the effectiveness of mHealth strategies, such as SMS reminders and voice messages, in increasing immunization uptake and reducing dropouts in LMIC settings.^{12–23}

Promotion of Breastfeeding Practices: Six studies evaluated the impact of mobile health technologies on promoting the breastfeeding in low- and middle-income countries (LMICs). These included five studies “Randomized Controlled trials” and one “Quasi-experimental” study. Of these, 6 studies reported that m-Health interventions had a positive impact on breastfeeding practices among mothers.^{24–29}

Two studies conducted in Bangladesh demonstrated significant improvements in exclusive breastfeeding (EBF) rates with m-Health interventions. According to one study, the intervention group's exclusive breastfeeding (EBF) rates were 16% greater than those of the control group (RR:1.16 [95% CI:1.083–1.23])²⁴ Another study emphasized the lasting impact of combining hospital support with mobile phone counselling, leading to increased EBF rates in community settings following hospital deliveries.²⁵

A study using text and voice messages reported higher rates of EBF up to six months (OR:2.4 [95%CI:1.4–4.0]) and timely initiation of breastfeeding (OR:2.6 [95% CI:1.6–4.1]) among intervention group than other group.²⁶ Similarly, a study conduct-

ed in Kenya found improved EBF practices and early contraceptive use practice observed at 10 week, 16 weeks and 24 weeks among mothers those receiving both one way and two-way SMS interventions ($p < 0.005$).The two-way SMS intervention showed additional benefits in maintaining EBF practices over time.²⁷

In India, a combination of weekly mobile phone counselling and daily text messages, along with routine healthcare services in the intervention group were found significant improvement of rates of timely initiation of breastfeeding than comparison group (37% vs. 24%, $p < 0.001$). However, the pre-lacteal feeding rates among both groups were found low and similar. (Intervention group=19%, control group=18%, $p=0.68$).²⁸

In contrast, a study in South Africa found no statistically significant difference in exclusive breastfeeding (EBF) rates between the video intervention mothers than control group. However, at the one-month follow-up, it was discovered that moms' understanding had significantly and somewhat improved.²⁹

Monitoring of growth and development: Two studies identified the impact of m-health intervention on monitoring of the growth and development of the children in low- and middle-income countries (LMICs). One study was quasi-experimental and other one is methodological. Both of the studies emphasizing the important role of m-health in monitoring of growth and development.^{30,31}

A study carried out in Kenya evaluated how m-health technologies affected the adoption of routine growth monitoring (RGM) by parents of children between the ages of nine and eighteen months. Caregivers in the intervention group of this trial got voice calls and brief text messages. It was discovered that, in comparison to the control group, caregivers who received STM were 6.875 times more likely to take their kids to routine growth monitoring during the first month. Similarly, compared to the control group, caregivers who got video calls were 6.750 times more likely to keep an eye on the child's routine growth. The study's conclusions suggested using m-health technologies to enable caregivers to give regular growth and development top priority.³⁰

The Second study conducted in Egypt, associated the development and deployment of the “Sehhat Tefly” Mobile application. This app was specifically designed for the mothers of the under-5-year children targeting the needs. This app includes various features like physical growth, tracking of growth, milestones, immunization, and nutrition guidance, teething care, safety and emergency information. This app received quality rating 3.7 out of 5 from panel experts and it was downloaded 1,445 times over four months of period. That shows the usability and popularity of the app among users.³¹

Health seeking behaviour among mothers: We retrieved two (RCTs) studies to identify the impact of

Table 2: Attributes of the studies incorporated

S. No	Author & year	Type	Country	Sample size	Outcome of M-health
Studies related to Impact of M-health in Immunization coverage of under-5-year children in LMICs					
1	Yunusa U et.al, 2024 ¹⁵	Randomized controlled trial	Nigeria	275	Children in the intervention group showed significantly higher rates of vaccine series completion (61.5%, n = 169) and timeliness (50.2%, n = 138) than the other group (13.4%, n = 35 for completeness; 5%, n = 13 for timeliness), with both differences being statistically significant (p < .001).
2	Mekonnen ZA, 2021 ¹⁸	Randomized controlled trial	Ethiopia	434	Results revealed that 95.8% infants in trial group were getting Pentavelent-3 than the non-trial group (86.9%, 185/213; p < .001). Similarly, 91.5% children in trial group were vaccinated for measles than control group "79.3%" at "p < .001 level", 82.6 % achieved complete vaccination vs. 70.9%, at p = .002.
3	Ibraheem R, 2021 ¹⁶	Randomized controlled trial	Nigeria	140	After 9-month visit, coverage of immunization among children were 99.2% for Group A (immunization reminders), 99.3% for Group B (immunization facts and SMS messages), 97% for Group C (usual care control), and 90.4% for Group D (reminders sent a day before the appointment). Group A had more likelihood of timely completion of vaccinations than among control group "[AOR 8.78 (95% CI: 6.10–12.63)]", followed by other Group B [AOR 2.56 (95% CI: 1.96–3.35)] and Group C "[AOR 2.44 (95% CI: 1.87–3.18)]".
4	Ekhaguere OA et.al, 2019 ²³	Randomized controlled trial	Nigeria	300	When combined, automated call and text reminders, immunization completion and timeliness improved significantly.
5	Dissieka R, 2019 ¹⁹	Randomized Controlled trial	Cote d'Ivoire	1,596	Mobile phone message reminders for mothers increased immunization and Vitamin A supplementation coverage.
6	Odinaka K, 2018 ¹⁷	Descriptive cross-sectional	Nigeria	253	A large majority (75.9%) believed that reminders can help decrease missed immunization appointments, and a significant number (61.7%) of mothers expressed interest in receiving phone reminders for their babies' immunization appointments.
7	Gibson DG, 2017 ¹³	Cluster-randomised controlled trial	Kenya	1600	Using the M-SIMU app, 1375 out of 1600 children (86%) successfully followed up and achieved the primary outcome of full immunization by 12 months of age.
8	Haji A et.al, 2016 ¹⁴	Randomized Controlled trial	Kenya	1,116	Participants who received text messages were less likely to drop out as compared to non-trial group "(OR 0.2, [95% CI: 0.04–0.8])."
9	Uddin MJ et.al, 2015 ²⁰	Quasi-experimental pre-post study	Bangladesh	518.	The "mTika" app has proven to be a feasible solution for improving vaccination coverage in both remote rural areas and urban street-dweller communities in Bangladesh, showing measurable health benefits.
10	Eze G et.al, 2015 ²²	Randomized controlled trial	Nigeria	905	Clients in the Intervention group received DPT3 vaccination 1.5 times earlier than those in the Control group. Additionally, immunization coverage was 8.7% higher in the Intervention group.
11	Schlumberger M et.al, 2015 ²¹	Randomized Controlled trial	West Africa	523	A statistically significant increase in vaccination coverage was observed among children whose parents received SMS reminders (p < 0.001).
12	Bangure D et.al, 2013 ¹²	Randomized controlled trial	Zimbabwe	304	The intervention group's immunization coverage at six weeks was 97%, while for the control group was 82% (p<0.001). The usage of SMS reminders is responsible for the overall increase in vaccine coverage.
Studies related to Impact of M-health on the promotion of Breastfeeding in LMICs,					
13	Billah SK et.al, 2022 ²⁴	Randomized controlled trial	Bangladesh	1500	Breastfeeding counselling, along with practical demonstrations using an electronic job aid by community health workers (CHWs), proved to be an effective approach for

S. No	Author & year	Type	Country	Sample size	Outcome of M-health
14	Adam M et.al, 2021 ²⁹	Randomized controlled trial	South Africa	1,502	promoting exclusive breastfeeding (EBF) and can be integrated into existing community-based programs.
15	Jerin I, 2020 ²⁵	Quasi-experimental study	Bangladesh	129	Regarding exclusive breastfeeding (EBF) rates and other infant feeding practices, no discernible differences were seen between the video intervention and the control group. The EBF rate over the previous 24 hours was 0.93 at one month "(95% CI: 0.86 to 1.01, p= 0.091)" and 0.90 at five months "(95% CI: 0.77 to 1.04, p= 0.152)". However, a small but significant improvement in maternal knowledge was noted at the one-month follow-up, with no similar improvement at the 5-month follow-up.
16	Unger JA et.al, 2018 ²⁷	Randomised trial	Kenya	300	Following hospital birth, exclusive breastfeeding (EBF) rates were consistently higher when community-based mobile phone counselling and hospital care were combined.
17	Patel A, 2018 ²⁸	Randomised trial	India	1,036	Early contraceptive use and exclusive breastfeeding (EBF) habits were enhanced by both one-way and two-way SMS. Furthermore, two-way SMS showed additional benefits in maintaining EBF, highlighting that SMS messaging can effectively promote interventions that improve maternal and neonatal health.
18	Flax VL, 2014 ²⁶	Randomized controlled trial	Nigeria	390	Compared to the control group, the intervention group's rate of timely breastfeeding initiation was considerably greater (37% vs. 24%, p < 0.001). With the help of mobile phones, high rates of exclusive breastfeeding at six months were attained.
Studies related to impact of M-Health on the Growth and development monitoring of the under-5-year children in LMICs					
19	Ibrahim NM, 2023 ³¹	Methodological study	Egypt	500	The intervention group had a higher chance of timely breastfeeding initiation (OR: 2.6; 95% CI: 1.6–4.1) and exclusive breastfeeding for up to six months (OR: 2.4; 95% CI: 1.4–4.0) than the control group.
20	Nyang'echi E, 2021 ³⁰	Quasi-experimental study	Kenya	180	Sehhat Tefly application was created to help mothers track the development and well-being of children under 5 years old. The app received an average quality rating of 3.7 out of 5 from a panel of experts. Over a four-month period, the app was downloaded 1,445 times.
Studies related to impact of M-Health on the health seeking behaviour of the mothers of under-5-year children in LMICs					
21	Musiimenta A, et.al, 2022 ³³	Randomized controlled trial	Uganda	80	Short text message recipients were 6.875 times more likely than the control group to take their kids for routine growth monitoring during the first month, according to the research (OR = 6.875; [95% CI: 3.591–13.164]). Also, compared to the control group, participants were "6.750" times more likely to take their kids for routine growth monitoring" were caregivers who received voice calls.
22	Talisuna AO, et.al, western, 2017 ³²	Randomized controlled trial	Kenya	1677	Unlike the women in the usual care group, all the mothers in the MatHealth App group made sure their infants were tested for HIV at six weeks and exclusively breastfed them.
					SMS reminders increased the chance that malaria patients would visit the hospital for post-treatment follow-up in this efficacy study, but they had no effect on artemether-lumefantrine (AL) adherence, which was high in both the control and intervention groups.

m-health intervention on health seeking behaviours among mothers in low- and middle-income countries (LMICs).^{32,33}

A study conducted in Kenya demonstrated the effectiveness of SMS reminders in improving the follow up visits of children after the malaria treatment to the health centre. The results depict that short message reminders significantly improved the likelihood of mothers taking their children to the health facilities after malaria treatment for follow up.³²

Another study conducted in Uganda, highlights the effectiveness of "MatHealth" application in improving the maternal knowledge related to child care and antenatal care. The findings suggested that MatHealth intervention group mothers were more likely to know the recommended gestational period for initiation of antenatal care (OR: 8.2, P=.19), the recommended number of ANC visits (OR: 3.6, P=.14), as compared to mothers who received routine care. Also, women's who were using MatHealth app exclusively breastfed their infants and ensure the timely HIV testing at 6 weeks.³³

DISCUSSION

The systematic review found supporting evidence that m-health is effective in certain health related outcomes in children like improvement of immunization status of the children, awareness and promotion of breastfeeding, regular monitoring of the child growth and improvement in the health seeking behaviour of the mother in low- and middle-income countries.

Number of studies had shown a positive impact of m-health on the coverage of immunization among children in different developing countries like Kenya, Nigeria, Zimbabwe and Ethiopia. Compared to the control groups, there was a reported rise in immunization rates in the intervention groups. According to a Zimbabwean study, the intervention group's immunization coverage at 6 weeks was 97% higher than that of the control group (p<0.001).¹²

Additionally, study conducted in Kenya located that the mothers of children who got reminders by SMS were significant more likelihood of fully immunized by 12 months.¹³ Likewise in Nigeria, SMS reminders were increased the likelihood of vaccination among children.¹⁶ Results highlights that m-health interventions are efficient in overcoming the obstacles in immunization like forgetfulness and reachability. Thus, it contributes to ensuring the timely and complete vaccination of children.

The analysed studies offered conclusive role of m-health in the promotion of breastfeeding practices. Out of six studies, five portrays significant improvement in Exclusive breastfeeding rates. A study conducted in Bangladesh had combined the mobile counselling with hospital support in intervention. The results showed that the intervention group's

EBF rates were 16% higher than those of the control group (RR:1.16 [95% CI:1.083-1.23]).²⁴

Moreover, Study conducted in Nigeria had use the text and voice messages to improve the timely initiation of breastfeeding (OR: 2.6 [95% CI: 1.6-4.1]) and also shows significant impact to sustained the EBF upto-6 months (OR 2.4 [95% CI: 1.4-4.0]).²⁶

Contrarily, a study conducted in South Africa had given a video-based m-health intervention to the mothers. It shows no significant improvement in breastfeeding practices. But it represents small but significant improvement of mother knowledge at 1month follow up.²⁹ Notably, two-way SMS interactions, as seen in a Kenyan study, provided additional benefits in sustaining EBF over time.²⁷ These findings suggest that mHealth can be a powerful tool to support breastfeeding when combined with culturally sensitive, multimodal approaches.

Although fewer studies explored the impact of mHealth on monitoring child growth and development, the available evidence suggests promising results. A study in Kenya showed that caregivers receiving SMS and voice call reminders were significantly more likely to attend routine growth monitoring sessions (OR: 6.875 [95% CI: 3.591-13.164]).³⁰

In Egypt, the Sehhat Tefly app offered comprehensive support for caregivers, including tracking growth, developmental milestones, immunizations, and nutrition. The app, rated positively by users, was downloaded over 1,400 times within four months. These findings highlight the utility of mHealth in engaging caregivers and improving routine child health monitoring. However, additional research is needed to evaluate the long-term outcomes and scalability of such interventions.³¹

Studies on impact of m-health intervention in enhancing mother's health seeking behaviour. A study conducted in Kenya reported that regular SMS reminders improved the follow-up visits of children in intervention group after malaria treatment; also, adherence to medication was equally high among both groups.³²

In Uganda, the app Mathealth shows significant improvement of the women knowledge on antenatal care, EBF and on time testing of the infant for HIV. It was found that the mothers who were in intervention group gave exclusive breastfeeding to the infant and also brought their infant to the clinic for HIV testing as compared to the routine care group. These findings demonstrated that m-health intervention can address critical gap in mother knowledge and practices and also helpful in improving seeking behaviour of the mothers in order to prevent the child from different illnesses.³³

This review restricted its search to peer-reviewed, English-language publications. Because our focus was on LMICs, we did not include research conducted in high-income countries, such as the studies that

examined the use of m-health in underprivileged or marginalized groups in such nations, which may have had different characteristics than that of LMIC residents. This process ensured precise categorization, comprehensive descriptive reporting, thorough quality assessment, and reliable comparison of effect measurements across heterogeneous studies.

IMPLICATIONS

Policy Implications: LMIC governments may integrate m-health interventions into national health programs to improve immunisation rates, breast-feeding, and growth tracking (e.g., voice calls, SMS reminders, mobile apps). **Funding and Resource Allocation:** The government can invest in scalable, cheap m-health technologies to improve healthcare delivery, especially in low-resource situations.

Community-based implementation: Health programmes should use mobile technologies to reach underserved and remote individuals to enhance access. Healthcare personnel training: Training healthcare professionals in m-health solutions can improve patient engagement and follow-up. M-health tactics must be tailored to specific regions based on cultural preferences, digital literacy, and language accessibility.

Further longitudinal study is needed to assess m-health's long-term effects on child health. Future studies should compare m-health techniques to determine which improve child health. Tests of usability and economic viability can help m-health grow nationally and internationally.

CONCLUSION

This review highlights the efficacy of m-health interventions in improving child health outcomes in LMICs. M-health interventions like voice calls, short message reminders and mobile applications had shown significant effect in improving the health seeking behaviour of the mothers, improve vaccination coverage, promoting breastfeeding practices and regular growth monitoring of the child.

Effectiveness of m-health may vary depending on various factors like which type of m-health strategy was adopted, which health outcomes were targeted and availability of technology in local language. However, more research studies are needed to evaluate the long-term impact of these interventions and identify the best strategies for various populations and to assess its efficacy in early detection, prevention, and management of common childhood illnesses. This review contributes valuable insights to guide policy decisions, resource allocation, and future research planning for m-Health interventions to reduce U-5MR in LMICs, ultimately advancing the global goal of reducing preventable child deaths.

REFERENCES

1. World Health Organization. Child mortality and cause of death. Available from: <https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/child-mortality-and-causes-of-death>. Accessed on Feb 14th 2025
2. World Health Organization. Child mortality (under 5 years): 2022. Available from: <https://www.who.int/news-room/fact-sheets/detail/children-reducing-mortality>. Accessed on Nov 10th 2024
3. Rupere T, Mavhemwa PM, Zanamwe N, et al. Effectiveness of an integrated M-Health platform for disease control. *International Journal of Computer Science Engineering*.2013 Mar; 2(2):13-29.
4. Davis DW, Logsdon MC, Vogt K, Rushton J, et al. Parent Education is Changing. *MCN the American Journal of Maternal/Child Nursing*.2017 Jun 20;42(5):248-56. DOI: <https://doi.org/10.1097/NMC.0000000000000353> PMID:28639997
5. Kabongo EM, Mukumbang FC, Delobelle P, Nicol E. Explaining the impact of mHealth on maternal and child health care in low- and middle-income countries: a realist synthesis. *BMC Pregnancy Childbirth*. 2021 Mar 9;21(1):196. dDOI: <https://doi.org/10.1186/s12884-021-03684-x> PMID:33750340
6. Mbunge E, Sibiyi MN. Mobile health interventions for improving maternal and child health outcomes in South Africa: a systematic review. *Global Health Journal*.2024;8(3):103-12. DOI: <https://doi.org/10.1016/j.glohj.2024.08.002>
7. Knop MR, Nagashima HM, Lin R, et al. Impact of mHealth interventions on maternal, newborn, and child health from conception to 24 months postpartum in low- and middle-income countries: a systematic review. *BMC Medicine*.2024 May 15;22(1):196. DOI: <https://doi.org/10.1186/s12916-024-03417-9> PMID:38750486 PMID:PMC11095039
8. Balogun MR, Boateng GO, Adams YJ, et al. Using mobile phones to promote maternal and child health: knowledge and attitudes of primary health care providers in southwest Nigeria. *Journal of Global Health Reports*. 2020;4:e2020060. DOI: <https://doi.org/10.29392/001c.13507>
9. Kang H, Kaur A, Saini S, et al. Pregnancy-Related Health Information-Seeking behavior of rural women of selected villages of North India. *Asian Women*.2022 Jun 30;38(2):45-64. DOI: <https://doi.org/10.14431/aw.2022.6.38.2.45>
10. Kang H, Kaur M, Raghuvanshi S. Knowledge and attitude of Indian parous women toward human milk banking. *Indian Journal of Community Medicine*.2019 Jan 1;44(2):175. DOI: https://doi.org/10.4103/ijcm.IJCM_377_18 PMID:31333302
11. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for Systematic Reviews and Meta-Analyses: the PRISMA statement. *PLoS Medicine*.2009 Jul 20;6(7):e1000097. DOI: <https://doi.org/10.1371/journal.pmed.1000097> PMID:19621072 PMID:PMC2707599
12. Bangure D, Chirundu D, Gombe N, et al. Effectiveness of short message services reminder on childhood immunization programme in Kadoma, Zimbabwe - a randomized controlled trial, 2013. *BMC Public Health*.2015 Feb 11;15(1):137. DOI: <https://doi.org/10.1186/s12889-015-1470-6>
13. Gibson DG, Ochieng B, Kagucia EW, et al. Mobile phone-delivered reminders and incentives to improve childhood immunisation coverage and timeliness in Kenya (M-SIMU): a cluster randomised controlled trial. *The Lancet Global Health*. 2017;5(4):e428-38. DOI: [https://doi.org/10.1016/S2214-109X\(17\)30072-4](https://doi.org/10.1016/S2214-109X(17)30072-4) PMID:28288747
14. Haji A, Lowther S, Ngan'ga Z, et al. Reducing routine vaccination dropout rates: evaluating two interventions in three Kenyan districts, 2014. *BMC Public Health*.2016 Feb 16;16:152. DOI: <https://doi.org/10.1186/s12889-016-2823-5>
15. Yunusa U, Garba SN, MacDonald SE, et al. Utilization of mobile reminders in improving the completeness and timeliness of

- routine childhood immunization in Kano Metropolis, Nigeria: a randomized controlled trial. *Journal of Pediatric Health Care*.2024 ;38(5):727-736. DOI: <https://doi.org/10.1016/j.pedhc.2024.03.002> PMID:38551537
16. Ibraheem R, Akintola M, Abdulkadir M, et al. Effects of call reminders, short message services (SMS) reminders, and SMS immunization facts on childhood routine vaccination timing and completion in Ilorin, Nigeria. *African Health Sciences*.2021 ;21(2):951-959. DOI: <https://doi.org/10.4314/ahs.v21i2.57> PMID:34795755 PMCID:PMC8568234
 17. Odinaka K, Edelu B, Achigbu K. Acceptance of mobile phone short message service for childhood immunisation reminders by Nigerian mothers. *Port Harcourt Medical Journal*. 2018 Jan 1;12(3):127. DOI: https://doi.org/10.4103/phmj.phmj.42_17
 18. Mekonnen ZA, Gelaye KA, Were M, et al. Effect of mobile phone text message reminders on the completion and timely receipt of routine childhood vaccinations: Superiority randomized controlled trial in Northwest Ethiopia. *JMIR Mhealth and Uhealth*. 2021 Jun 15;9(6):e27603. DOI: <https://doi.org/10.2196/27603> PMID:34128813 PMCID:PMC8277338
 19. Dissieka R, Soohoo M, Janmohamed A, et al. Providing mothers with mobile phone message reminders increases childhood immunisation and vitamin A supplementation coverage in Côte d'Ivoire: a randomised controlled trial. *Journal of Public Health in Africa*. 2019 Jun 19;10(1):a895. DOI: <https://doi.org/10.4081/jphia.2019.1032> PMID:31285815
 20. Uddin MdJ, Shamsuzzaman Md, Horng L, et al. Use of mobile phones for improving vaccination coverage among children living in rural hard-to-reach areas and urban streets of Bangladesh. *Vaccine*.2015 Nov 29;34(2):276-83. DOI: <https://doi.org/10.1016/j.vaccine.2015.11.024> PMID:26647290
 21. Schlumberger M, Bamoko A, Yaméogo TM, et al. Positive impact on the Expanded Program on Immunization when sending call-back SMS through a Computerized Immunization Register, Bobo-Dioulasso. *Bulletin de la Societe de Pathologie Exotique*.2015 Dec; 108(5): 349-54. DOI: <https://doi.org/10.1007/s13149-015-0455-4> PMID:26498331
 22. Eze G, Adeleye O. Enhancing routine immunization performance using innovative technology in an urban area of Nigeria. *West African Journal of Medicine*.2015 Jan-March;34:3-10.
 23. Ekhaguere OA, Oluwafemi RO, Badejoko B, et al. Automated phone call and text reminders for childhood immunisations (PRIMM): a randomised controlled trial in Nigeria. *BMJ Global Health*.2019 ;4(2):e001232. DOI: <https://doi.org/10.1136/bmjgh-2018-001232> PMID:31139442 PMCID:PMC6509606
 24. Billah SM, Ferdous TE, Siddique AB, et al. The effect of electronic job aid assisted one-to-one counselling to support exclusive breastfeeding among 0-5-month-old infants in rural Bangladesh. *Maternal and Child Nutrition*.2022 May 19; 18(3): e13377. DOI: <https://doi.org/10.1111/mcn.13377>
 25. Jerin I, Akter M, Talukder K, et al. Mobile phone support to sustain exclusive breastfeeding in the community after hospital delivery and counseling: a quasi-experimental study. *International Breastfeeding Journal*. 2020 Mar 4;15:14. DOI: <https://doi.org/10.1186/s13006-020-00258-z>
 26. Flax VL, Negerie M, Ibrahim AU, et al. Integrating Group Counseling, Cell Phone Messaging, and Participant-Generated Songs and Dramas into a Microcredit Program Increases Nigerian Women's Adherence to International Breastfeeding Recommendations. *Journal of Nutrition*.2014 May 9;144(7):1120-4. DOI: <https://doi.org/10.3945/jn.113.190124> PMID:24812071
 27. Unger J, Ronen K, Perrier T, et al. Short message service communication improves exclusive breastfeeding and early postpartum contraception in a low- to middle-income country setting: a randomised trial. *BJOG an International Journal of Obstetrics & Gynaecology*.2018 Jun 20;125(12):1620-9. DOI: <https://doi.org/10.1111/1471-0528.15337> PMID:29924912
 28. Patel A, Kuhite P, Puranik A, et al. Effectiveness of weekly cell phone counselling calls and daily text messages to improve breastfeeding indicators. *BMC Pediatrics*. 2018 Oct 30;18:337. DOI: <https://doi.org/10.1186/s12887-018-1308-3>
 29. Adam M, Johnston J, Job N, et al. Evaluation of a community-based mobile video breastfeeding intervention in Khayelitsha, South Africa: The Philani MOVIE cluster-randomized controlled trial. *PLoS Medicine*.2021 Sep 28;18(9):e1003744. DOI: <https://doi.org/10.1371/journal.pmed.1003744>
 30. Nyang'echi E, Osero J. Effects of Mobile Health Technologies on Uptake of Routine Growth Monitoring among Caregivers of Children Aged 9 to 18 Months in Kenya. *J Prim Care Community Health*. 2021 Jan-Dec;12:21501327211010995. DOI: <https://doi.org/10.1177/21501327211010995>
 31. Ibrahim NM, Ez-Elarab HS, Momen M, et al. A novel wide scale well-baby clinic mobile application: an Egyptian pilot study. *BMC Health Services Research*.2023 June;23:687. DOI: <https://doi.org/10.1186/s12913-023-09720-0>
 32. Talisuna AO, Oburu A, Githinji S, et al. Efficacy of text-message reminders on paediatric malaria treatment adherence and their post-treatment return to health facilities in Kenya: a randomized controlled trial. *Malaria Journal*.2017 Jan 25;16:46. DOI: <https://doi.org/10.1186/s12936-017-1702-6>
 33. Musiimenta A, Tumuhimbise W, Atukunda EC, et al. A mobile health app may improve maternal and child health knowledge and practices among rural women with limited education in Uganda: a pilot randomized controlled trial. *JAMIA Open*. 2022 ;5(4):ooac081. DOI: <https://doi.org/10.1093/jamiaopen/ooac081>